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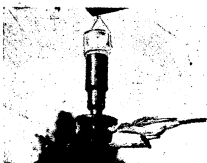
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few authors who did claim to write from an original viewpoint and original data were poorly informed, and their books accordingly range from the merely naive to the downright ludicrous.

Now at long last we are beginning to see some popular books on ants that are reasonably up-to-date and which, at the same time, get close to being factually accurate. The most important by far is John H. Sudd's *AN INTRODUCTION TO THE BEHAVIOUR OF ANTS*, an extremely rich mine of ant lore based largely on the investigations of the last twenty years.

Sudd's book is admirably compact and businesslike. To be sure, the writing is often awkward, partly because the author follows the regrettable tendency to conophilia, now epidemic in British technical writing. But for the most part he is clear because his sentences are very short. Sudd's record—and it seems to be representative—shows that the main advances in the knowledge of ant behavior since World War II have been made in Britain, Germany, and the United States.

Particularly spectacular have been the discoveries on food-sharing behavior based on radioactive labeling techniques, and the growing appreciation of the role played by pheromones—specific chemicals that elicit adaptive responses from other members of the species—in the communal life of ants as well as other social insects.

Pheromones are to insect societies what hormones are to individual animals and language is to human societies. This chemical communication, mediated through the senses of smell and taste, is a basic inheritance from nonsocial insects, in which pheromones are important mainly in courtship, and secondarily in territorial behavior.

Sudd's chapter on ant navigation is particularly interesting, and summarizes a great many observations, of which a number were not widely known until now. Ants find their way by visual orientation with respect to the sun and landmarks, and by means of odor trails, or combinations of these. Gravity is also taken into account when an ant shifts its position. Pathfinding of course differs greatly in ant species that live under different environmental conditions.

These and many more topics in ant behavior are dealt with in the book, and it is easily the most complete and critical work on the subject available. I do have a few criticisms, the most general of which is that some accounts of other authors are accepted by Sudd without the skepticism they deserve. There are also a few particular errors of fact. The spines of *Acacia* that swell to make ant domiciles apparently enlarge by themselves, and the swelling is not caused by "some unidentified disease." No one (least of all this reviewer) has ever laid the paucity of thorns and the lack of ant



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symbionts in Australian *Acacia* to the "poorness of the Australian ant-fauna." Rather, the Australian ant fauna is exceedingly rich, and may well include 2,000 species. No comparable land area on Earth has more.

Sudd feels that "the effects of ants on the distribution of plants are not very striking," yet evidence exists to the contrary. In fact, a good many common plants, including our white trillium, bell-wort, and bloodroot, have seeds that are distributed mainly by ants. In deserts, seeds of ant-gathered species often sprout and form rings around ant nests.

But such lapses are minor when they accompany so much good information so interestingly set forth.

The other two books under review fall far short of Sudd's standards of completeness and up-to-dateness so far as the text is concerned; but for the casual reader this lack may be compensated for by the high quality and profusion of their photographic illustrations. *ANTS FROM CLOSE UP* concentrates on the details in the life history of a "typical" species—one of the wood-ants of the *Formica rufa* complex. The subjects and the context are predominantly British, but fine photographs, particularly those by Edward S. Ross and M.F.W. Tweedie, also bring in a few interesting exotic subjects.

THE ANT REALM concentrates more on the variety of ants and their habits

around the world. The photographs are mostly very good indeed, and many of them are of subjects never before shown photographically in print. Occasional photographs are crudely posed or grossly mis-labeled, as with one captioned, "An *Atta* queen (left) is very large in comparison to her workers." The photograph shows an *Atta* queen looming over a single worker of the harvester ant genus *Pogonomyrmex*.

The drawings in Hutchins' book are decorative, but sometimes inaccurate. The leaves of his *Cecropia* ant-tree are quite unlike the real thing; his Baltic amber *Lasius* is nearly as large as the ginkgo leaves and fruits with which it is shown, and on this scale would be about an inch long instead of the four millimeters or so that it really measures; his *Prionomyrmex* is badly drawn, and is shown with eight segments in the right antenna and seven in the left, instead of the twelve both antennae really possess.

In both books, the text contains more than a reasonable number of inaccuracies, ranging from misspellings of scientific names (this class of errors, it must be admitted, is also too frequent in Sudd's book) to the repetition of old errors, such as the claim that *Pholidole* harvester "miller caste" heads found scattered about the nest entrance in Arizona represented post-season sister-murders after "their work for the year was ended and

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species to modern counterparts. A more serious misunderstanding is embodied in Hutchins' statement. "The fact remains that even though the world and most of its animals have changed greatly, the ants apparently have changed but little." The real truth of the matter is that with the few exceptions mentioned, the Baltic amber ant fauna was very different from that which exists in Europe or anywhere else today. The dominant amber ants of genus *Iridomyrmex* (different species) are today confined to the Indo-Australian region and the New World (except for the man-introduced Argentine ant, which has invaded Mediterranean shores).

Other ants of genus *after* genus represented in the Baltic amber are today extinct, while such huge, world-dominating genera as *Phlebotomus* and *Crematogaster* are absent from the amber, and there is no good reason to believe that they existed that early anywhere. The impression is gained from THE ANT REALM (and also from some well-known books on evolutionary theory) that ant evolution has been stagnant since Baltic amber times. This impression needs correction.

The points of criticism I have raised could be multiplied three times for these two latter books. This adds up to a lot of errors, far too many it seems to me, even for popular-science editions. This is a shame, for in many ways both books are an advance over the usual potholer on the subject. They demonstrate amply that the photographic problems of such a book are more easily solved than is the composition of an accurate text or drawn figures. But with all their irritating faults, these books, particularly Sudd's, are better than anything else in their class, and they deserve a place on the complete natural history bookshelf.

THE WORLD OF THE ANT belongs to the same class as do the books by Newmann and Hutchins. Like them, it is profusely illustrated with fine photographs, in this case all black-and-white, most taken by the author. Occasional photographs, such as the full-page landscape captioned "Harvester ant country in the Oregon desert," include no ants or the works of ants so far as I can see, and their relevance seems a bit tenuous.

Costello, who has been engaged in range management research for 30 years, in some ways gives us a fresh glimpse of semidesert ant ecology, but it is scarcely more than a glimpse, and things sometimes get confusing. The caption to one illustration tells us that "When cattle graze so closely that few plants can produce seeds, the harvester ant population is low. It will increase if grazing diminishes." But on the preceding page, we

Dr. William L. Brown, Jr., is professor of entomology at Cornell University. He has done extensive research on ants and has published more than 180 scientific articles on them.

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read: "The cows overgraze the grasses, a weedy plant cover develops with its seed supply relished by ants, and the ants increase in numbers." Obviously, we need a fuller explanation of the ant-livestock interaction.

The information in Costello's book is presented in four principal chapters, one for each season. This arrangement tends to fragment his account of the life history of the colony, and in fact the author does not always stick very close to the subjects of his own titles. Thus he covers a great deal of information in a somewhat disjointed way. Like the other books, this one has its errors and over-implications of fact and hypothesis, but they are not excessive. Coverage of the literature is of course very selective, but includes mention of much modern work on ant behavior and pheromones without going into depth on these subjects.

Speculation of former authors are occasionally accepted without the skepticism they deserve—for instance:

"The highly developed ants have thin integuments, are capable of producing large colonies, have greater intelligence, since their thin armor permits closer contact of the senses with the environment."

This statement betrays scant appreciation of what we know about the ant's sensory anatomy and physiology, or for the apparent evolutionary ascendancy of the "hard-shelled" Myrmecinae over the relatively "thin-shelled" Formicidae and Dolichoderinae. In spite of these shortcomings, the book is an engaging and substantial one, and it shows a laudable awareness of the broad ecological aspects of ant biology. ■

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